

PLIOCENE MARINE DEPOSITS IN NORTHWESTERN BAJA CALIFORNIA, MEXICO, WITH THE DESCRIPTION OF A NEW SPECIES OF *ACANTHINA* (GASTROPODA)†

By LEO G. HERTLEIN* AND EDWIN C. ALLISON**

Pliocene sediments with marine invertebrate fossils occur at several locations in northwestern Baja California. They have been mentioned only incidentally in the literature dealing with that region except for one brief account (Santillán and Barrera, 1930, pp. 20-25). Recent studies of the geology and Pliocene paleontology of southwestern San Diego County, California (Hertlein and Grant, 1944) reveal, by comparison, the dearth of information concerning contemporary faunas in immediately adjacent portions of the State of Baja California, Mexico. To supply information concerning this area we have prepared the present paper presenting the results of recent field work together with a compilation of the findings of Santillán and Barrera, published and unpublished.

The previously unpublished descriptions of fossil localities collected by Santillán and Barrera, University of California Museum of Paleontology localities A-433 through A-470, are exceedingly brief and not in complete agreement with plotted positions on a reconnaissance map presumably prepared from notes of these collectors. Localities from which collections of fossils have been obtained recently are located on the sketch map (Plate 7) with greater precision.

The writers wish to acknowledge the aid of several individuals who assisted in the field work or who contributed information which has aided in the preparation of this paper. These include: Dr. W. K. Emerson, A. Allanson, J. A. Van Couvering, F. H. Kilmer, and R. H. Tedford. All have participated in this work as students or employees of the University of California. Mr. Ira E. Cornwall, Victoria, British Columbia, kindly identified the species of barnacle cited in this paper.

GEOLOGICAL SETTING

EDWIN C. ALLISON

North of the Vizcaíno Bay and Peninsula (Beal, 1948; Mina, 1956, 1957), marine Pliocene deposits along the west coast of Baja California are generally limited to thin, flat-lying, discontinuously distributed, near-shore deposits resting on a variety

†Contribution from the Department of Paleontology, California Academy of Sciences, and the Museum of Paleontology, University of California.

*Associate Curator, Department of Geology, California Academy of Sciences.

**Museum Paleontologist, University of California Museum of Paleontology.

of older rocks. Santillán and Barrera (1930, pp. 20-25) noted the occurrence of some of the marine, fossil-bearing, Pliocene deposits between El Rosario and San Antonio del Mar and designated them the Cantil Costero formation, noting occurrences especially in the area between El Rosario and San Ramón (east of San Quintín Bay). That area would provide, by inference, the type locality (or typical occurrence) for the Cantil Costero formation. Beal (1948, pp. 77-81) interpreted the Salada formation of Heim (1922, pp. 544-546) broadly to include all marine Pliocene rocks of the Baja California Peninsula, including those described by Santillán and Barrera. The Salada formation, as the name was used originally by Heim, pertained only to exposures in Arroyo Salada, near Magdalena Bay. Santillán and Barrera's Cantil Costero formation applies most appropriately to marine Pliocene deposits now known in western Baja California from El Rosario northward.

The Cantil Costero lithology is dominated by varying proportions of conglomerate and sandstone, generally poorly sorted and friable. Clasts have been derived mainly from volcanic and intrusive rocks of the Cretaceous Alisitos formation and associated plutons (Table 1). Thickness of the Cantil Costero formation is not known to exceed 5 meters. Exposures usually occur at elevations greater than 100 meters and at distances of a few kilometers inland from the present shore line.

Post-Pliocene marine deposits (Emerson, 1956, pp. 323-324) generally occur at lower elevations than do fossiliferous beds of the Cantil Costero formation. Topographically highest marine deposits which are demonstrably Pleistocene are located on the north side of Cabo Colnett (University of California Museum of Paleontology localities V-5123, V-5686, V-5728, and B-3080) where both marine invertebrates (*Dendraster excentricus*) and terrestrial vertebrates (deer, ground sloths, antilocaprids, and caballine horses) occur at an estimated elevation of 50 meters¹.

Rocks varying greatly in age underlie the Cantil Costero formation, usually without marked discordance. Fossiliferous Pliocene arenaceous sediments lie conformably on late Tertiary basalts at one of the more northern localities, B-3066. Southward, in the vicinity of El Rosario, Pliocene deposits rest on the late Cretaceous Rosario formation. The Cantil Costero formation overlies variegated reddish and greenish colored beds east of San Quintín Bay, in the central part of the area containing outcrops of Pliocene deposits. These variegated beds represent

¹Vertebrate fossils collected by A. Allanson, J. A. Van Couvering, F. H. Kilmer, and E. C. Allison have been examined by R. H. Tedford of the University of California Museum of Paleontology. His report states that the assemblage is clearly Pleistocene in age, but that a more refined age determination is at present impossible.

nonmarine deposition during part of the interval of time extending from late Cretaceous through Tertiary. Similar nonmarine sediments contain large fossil reptiles west of El Rosario but north of Cabo Colnett these lie stratigraphically between a thin marine Paleocene formation and Pleistocene deposits.

Table 1. GENERALIZED STRATIGRAPHY OF WESTERN BAJA CALIFORNIA BETWEEN ENSENADA AND EL ROSARIO

Rock Unit	Lithology	Maximum Thickness	Age
	Marine and nonmarine coarse sediments (usually terrace deposits)	20 meters	Pleistocene
Cantil Costero	Marine coarse sediments	5 meters	Pliocene
	Basic volcanic rocks	20 meters	? Miocene-Pleistocene
	Nonmarine sediments	100 meters	Cenozoic undifferentiated
Sepultura	Marine sediments with local algal limestones*	20 meters	Paleocene
Rosario	Marine sediments	300 meters	late Upper Cretaceous
	Nonmarine sediments	200 meters	Upper Cretaceous
	Nonmarine clastic and pyroclastic rocks	150 meters	? late Lower Cretaceous
Alisitos	Marine volcanic and immediately derived sedimentary rocks with interbedded biohermal and bio-clastic limestones	5000 meters	late Lower Cretaceous
	Plutons of the peninsula range Batholith (intrude Alisitos rocks; truncated by Rosario sediments) Upper Cretaceous		

PALEONTOLOGY

LEO G. HERTLEIN AND EDWIN C. ALLISON

The fossils from Pliocene strata in northwestern Baja California, discussed in the present paper, are few in number and, in general, poorly preserved. Their occurrence is of interest because they clearly indicate the presence of discontinuous patches of strata of Pliocene age in the region between San Diego, California, (the fauna of the San Diego formation of Pliocene age is now receiving special study) and the fossiliferous beds of Pliocene age described at Turtle Bay, Baja California, by E. K. Jordan and Hertlein (1926), by Hertlein (1933), by Chace (1956), and by Mina (1956, 1957). Several species in the present list of fossils also occur in Pliocene strata of the region to the north or to the south.

*Algal limestones here cited may be of Eocene age.

The fossils discussed here were collected by Manuel Santillán and Tomás Barrera (1930), and by field parties from the department of paleontology, University of California, Berkeley, chiefly by William K. Emerson and Edwin C. Allison. One lot of oysters was collected by E. K. Jordan and L. G. Hertlein near San Antonio del Mar. The specimens considered, with the exception of a paratype of the new species described herein and the oysters collected by Jordan and Hertlein (which are in the collections of the California Academy of Sciences), are in collections of the University of California Museum of Paleontology.

The localities from which Pliocene fossils were collected in northwestern Baja California follow.

Loc. A-433 (Univ. Calif. Mus. Paleo.). North of El Rosario on mesa; M. Santillán and T. Barrera, colls.; field No. 20. [No fossils from this locality seen by present authors.]

Loc. A-434 (Univ. Calif. Mus. Paleo.). ?Near Loc. A-433 (U.C.), north of El Rosario; M. Santillán and T. Barrera, colls.; field No. 21. [No fossils from this locality seen by present authors.]

Loc. A-449 (Univ. Calif. Mus. Paleo.). Border of mesa northeast of El Rosario; M. Santillán and T. Barrera, colls.; field No. 35. [No fossils from this locality seen by present authors.]

Loc. A-450 (Univ. Calif. Mus. Paleo.). ?Near Loc. A-449 (U.C.); M. Santillán and T. Barrera, colls.; field No. 21. This locality bears the same field number as that at Loc. A-434 (U.C.) and therefore is similarly questionable. [No fossils from this locality seen by present authors.]

The four preceding collecting stations appear to be situated near the summit of the mesa northeast of El Rosario: apparently the Pliocene sediments overlie late Cretaceous strata of the Rosario formation.

Loc. 456 (Univ. Calif. Mus. Paleo.). Terrace east of San Quintín, between San Simón and Agua Chiquita; M. Santillán and T. Barrera, colls.; field No. 47.

Loc. 459 (Univ. Calif. Mus. Paleo.). Same horizon as that at Loc. A-456 (U.C.), north of Agua Chiquita; M. Santillán and T. Barrera, colls.; field No. 48.

Loc. 470 (Univ. Calif. Mus. Paleo.). Three miles (4.8 km.) above mouth of Coyotitos Creek [San Antonio del Mar]; M. Santillán and T. Barrera, colls.; field No. 63.

Fossils from localities A-456 (Univ. Calif. Mus. Paleo.) and A-459 (Univ. Calif. Mus. Paleo.) probably were collected near the summit of the mesa east of San Quintín Bay where the Cantil Costero formation overlies nonmarine strata of late Cretaceous or Tertiary age.

Loc. A-6522 (Univ. Calif. Mus. Paleo.). 8.2 miles (13.2 km.) south of Socorro; R. A. Stirton, coll., 1947. [The Cantil Costero formation probably overlies late Cretaceous strata of the Rosario formation at this locality.]

Loc. B-1404 (Univ. Calif. Mus. Paleo.). Sparsely fossiliferous sandstone and conglomerate exposed near top of bluffs about six miles (9.7 km.) east of San Quintín; Pliocene beds rest upon variegated reddish and greenish nonmarine sediments of late Cretaceous or Tertiary age; E. C. Allison, coll., 1951.

Loc. B-3066 (Univ. Calif. Mus. Paleo.). Shallow road metal quarry on west side of Ensenada-San Quintín highway, near kilometer marker 258; fossils occur in whitish friable sandstone which rests upon Tertiary basalt; W. K. Emerson and E. C. Allison, colls., 1956.

Loc. B-4300 (Univ. Calif. Mus. Paleo.). Near highway at Arroyo Amargo, north of El Rosario; beds probably overlying late Cretaceous sediments; T. Lawrence, coll., 1956.

Loc. 31785 (Calif. Acad. Sci.). Oysters near road on top of Colnett

Mesa, about three miles south of San Antonio del Mar; E. K. Jordan and L. G. Hertlein, colls., 1926.

List of species of Pliocene age from localities in northwestern Baja California. Locality numbers are arranged from north to south. The species accompanied by the symbol * indicates that specimens were seen by the present authors.

		North to South						
		A-470	31785 (C.A.S.)	B-3066	A-459	A-456	B-1404	A-6522
								B-4300
		Listed by Santillán and Barrera. Localities not differentiated. Identifications by B. L. Clark. Nomenclature that of current usage.						
Echinoidea								
<i>Dendraster ashleyi</i> Arnold.....								X
"Dendraster cf. <i>ashleyi</i> Kew".....								X
Pelecypoda								
* <i>Anomia</i> sp.				X				
<i>Arca</i> sp.								
<i>Hinnites multirugosus</i> Gale				X	X			
* <i>Mytilus</i> sp. (large)					X			
<i>Ostrea</i> sp.								
<i>Ostrea vespertina</i> Conrad		X	X					
* <i>Ostrea vespertina teatchii</i> Gabb.....						X		
* <i>Pecten bellus</i> Conrad							X	X
<i>Pecten circularis</i> Sowerby								
* <i>Pecten</i> cf. <i>P. gallegosi</i>								
E. K. Jordan & Hertlein								
* <i>Pecten etchegoini</i> Anderson				X				
* <i>Pecten</i> sp.						X	X	X
<i>Phacoides</i> , sp.							X	X
<i>Phacoides</i> sp.							X	X
<i>Pholadidea</i> sp.								
* <i>Spisula</i> cf. <i>S. hemphilli</i> Dall (cast)								
Gastropoda								
* <i>Acanthina emersoni</i> Hertlein & Allison, n. sp. [cited as " <i>Acanthina</i> n. sp." by Santillán and Barrera]....				X	X	X		
" <i>Alectrion californica</i> var."								
* <i>Cancellaria</i> cf. <i>C. crawfordiana</i> Dall								
* <i>Forreria</i> cf. <i>F. wrighti</i> E. K. Jordan & Hertlein				X				X
<i>Polinices</i> sp.								
* <i>Thais</i> aff. <i>T. etchegoinensis</i> Arnold		X	X					
* <i>Thais</i> cf. <i>T. haemastoma biserialis</i> Blainville								

	A-470	31785 (C.A.S.)		Listed by Santillán and Barrera. Localities not differentiated. Identifications by B. L. Clark. Nomenclature that of current usage.
* <i>Thais trancosana</i> Arnold	X	B-3066	X	N X
<i>Trophon</i> sp.....		A-459	X X	
<i>Turritella vancalecki</i> Arnold		A-456		
* <i>Turritella</i> sp.		B-1404	X	
Cirripedia		A-6522	X	
* <i>Balanus tintinabulum</i> Linnaeus		B-4300		
Shark teeth ["Diente de Tiburón"].....				
Skate "teeth" ["Diente de liza"].....				

The fossils cited in the foregoing list, when considered as a whole or from each locality, are indicative of Pliocene age. Among the species definitely identified, *Dendraster ashleyi*, *Ostrea vespertina*, *Ostrea vespertina vetchii* Gabb, and *Pecten bellus* Conrad, all occur both in the beds of Pliocene age at Turtle Bay, Baja California, and in the San Diego formation in southwestern San Diego County, California. These species and, in addition, *Pecten etchegoini* and *Turritella vanvlecki* are extinct. All these (with the possible exception of *Pecten bellus*) are known to occur only in beds of Pliocene age. Among the doubtfully identified species, *Spisula* cf. *S. hemphilli* is comparable to *S. hemphilli* occurring in the San Diego formation and *Pecten* cf. *P. gallegosi* and *Forreria* cf. *F. wrighti* are comparable to species which occur in Pliocene strata at Turtle Bay.

The occurrences of the species cited above suggest that the beds containing them in northwestern Baja California are comparable in age to those occurring in the San Diego area, California, and at Turtle Bay, Baja California, and are of late Pliocene age.

Descriptions of Species

Family Thaididae

Genus *Acanthina* Fischer de Waldheim

Acanthina emersoni Hertlein & Allison, new species

Plate 8, Figure 1

Shell of medium size, thick, whorls gently rounded (apex lacking); body whorl sculptured with about 18 low, flattish spiral ribs, separated by much narrower spiral grooves, some of the ribs bear a faint medial groove; the four anterior ribs are separated from the others by a well developed spiral groove which

represents the growth stages of a small tooth present at the edge of the outer lip; the penultimate whorl is sculptured with about 6 spiral ribs; all the ribs are crossed by fine, fairly even lines of growth; a deep anterior notch at the base of the aperture and a well developed siphonal fasciole present; about 5 or 6 spiral ribs are present on the interior of the outer lip; the inner lip consists of smooth callus. Height (apex lacking), 27.3 mm.; maximum diameter, 16.8 mm.; height of aperture, 20 mm.

Holotype (Univ. Calif. Acad. Mus. Paleo. Type Coll.), and paratype (Calif. Acad. Dept. Geol. Type Coll.), from Loc. A-459 (Univ. Calif. Mus. Paleo.), terrace north of Agua Chiquita, Baja California, Mexico; M Santillán and T. Barrera, colls., 1930 [their Loc. 48]; Pliocene. One specimen was collected at Loc. A-456, also one at Loc. B-3066 (Univ. Calif. Mus. Paleo.), in a quarry near kilometer marker 258 on the west side of the Ensenada-San Quintín highway, Baja California.

This new species bears a general resemblance to specimens of the Recent west American *Acanthina spirata* Blainville², especially those on which the whorls are rounded anteriorly. The fossil form here described possesses much more rounded whorls, the spiral ribs are much broader, occasionally bear a medial groove, and are separated by much narrower interspaces, the whole crossed by fine fairly even lines of growth which do not divide the interspaces into squarish pits as do those on the Recent species.

Acanthina emersoni, new species, appears to be more closely related to *Acanthina spirata* than it is to the South American species described as *Monoceros imbricatum* Lamarck or to the species with much wider ribs which occurs in Pliocene strata in Chile which was described under the name *Monoceros tenuis* Sowerby.

The general appearance of the exterior of this species is somewhat similar to that of worn specimens of *Thais lima* Gmelin, but the presence of a tooth on the anterior portion of the inner lip readily serves to separate this new fossil form from the species described by Gmelin.

This new species is named for Dr. William K. Emerson, Assistant Curator, Department of Mollusks, American Museum of Natural History, in recognition of his contributions to the knowledge of the Pleistocene invertebrate fauna of Baja California, Mexico.

²P[URPURA]. *spirata* Blainville, Nouv. Ann. Mus. d'Hist Nat. Paris, Vol. 1, p. 252, pl. 12, fig. 8, 1832. "Des îles Sandwich, d'où elle été rapportée par M.P.E. Botta." [This locality is erroneous. It is a west American species ranging from Mendocino County, California, to Cape San Lucas, Lower California, Mexico. Socorro Island (Dall).].—Kiener, Spéc. Gén. Icon. Coq. Viv., Fam. Purpurifères, Pourpre, p. 121, pl. 38, fig. 90, 1836. Original locality cited.

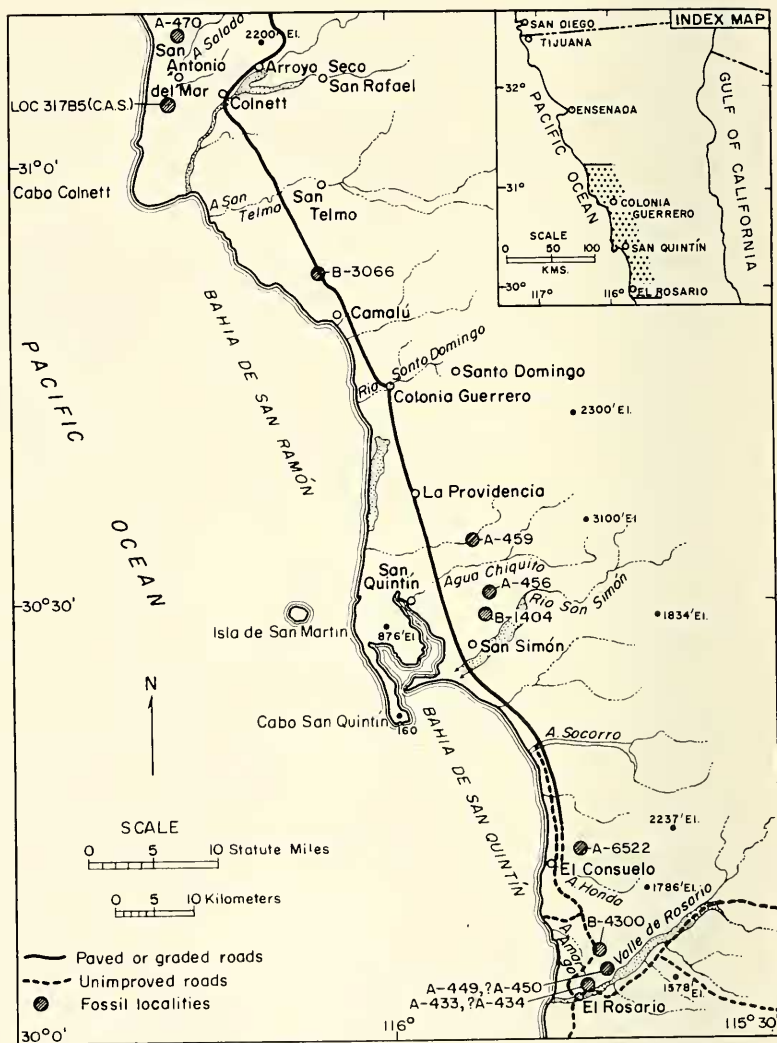


PLATE 7

Map of northwestern Baja California showing collecting stations and points of elevation. Adapted from United States Air Force Preliminary Base, Ensenada (472B), 1946 [revised 1954]. Scale 1:500,000.

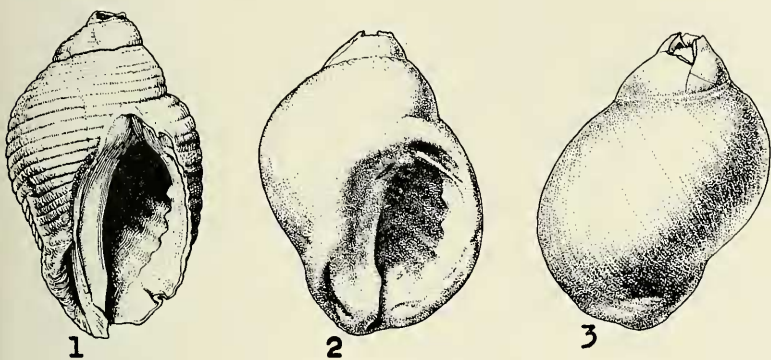


PLATE 8

Fig. 1. *Acanthina emersoni* Hertlein & Allison, new species. Holotype. Height, 27.3 mm.

Figs. 2 and 3. *Thais trancosana* Arnold. Hypotype. Height, 25 mm. Fig. 2. Apertural view. Fig. 3. View of opposite side of specimen shown in Fig. 2.

Thais trancosana Arnold

Plate 8, Figures 2 and 3

Thais trancosana Arnold, Proc. U. S. Nat. Museum, Vol. 34, No. 1617, p. 388, pl. 36, fig. 3, August 8, 1908.—Arnold, in Branner, Newsome and Arnold, U. S. Geol. Surv., Folio 163, p. 6, illustr., sheet II, fig. 74, 1909.

TYPE LOCALITY: "Santa Cruz Quadrangle, Santa Cruz County, locality No. 21, ditch between Feld [Felt] Lake and Los Trancos Creek, 2½ miles south-southwest of Stanford University." "Merced formation, upper Pliocene."

REMARKS: Two well preserved specimens of *Thais* and three imperfect ones were collected by W. K. Emerson and E. C. Allison at Loc. B-3066 (Univ. Calif. Mus. Paleo.), in a shallow quarry near kilometer marker 258 on the west side of the Ensenada-San Quintín highway, Baja California.

The larger specimens, only slightly decorticated at the apex, are about 25 mm. in height. We have compared these with casts of the type specimen of *Thais trancosana* Arnold and find that they agree in all observable details.

Characters of the shell which serve to aid in the separation of this species from the Recent *Thais lamellosa* Gmelin and *Thais ethegoensis* Arnold, a Pliocene species, are the lower spire,

the very rapidly enlarging whorls which are only slightly convex, and the very thick shell.

We have seen specimens of this species from various localities in the Merced formation in central California.

REFERENCES CITED

- Beal, C. H.
1948. Reconnaissance of the Geology and Oil Possibilities of Baja California, Mexico. Geol. Soc. America, Mem. 31, pp. 1-X, 1-138, pls. 1-11, tables 1-2, December 1.
- Chace, E. P.
1956. Additional Notes on the Pliocene and Pleistocene Fauna of the Turtle Bay Area, Baja California, Mexico. Trans. San Diego Soc. Nat. Hist., Vol. 12, No. 9, pp. 177-180, June 11.
- Emerson, W. K.
1956. Pleistocene Invertebrates from Punta China, Baja California, Mexico; with remarks on the Composition of the Pacific Coast Quaternary Faunas. Bull. Amer. Mus. Nat. Hist., Vol. 111, Art. 4, pp. 317-342, pls. 22, 23, text fig. 1 (map), tables 1-2, October 31.
- Gerhard, P., and Gulick, H. E.
1956. Lower California Guidebook (The Arthur Clark Co.: Glendale, California), pp. 1-218, pls. and maps.
- Heim, A.
1922. Notes on the Tertiary of southern Lower California (Mexico). Geol. Mag., Vol. 59, No. 702, pp. 529-547, pls. 21-22, figs. 1-7 in text, December.
- Hertlein, L. G.
1933. Additions to the Pliocene Fauna of Turtle Bay, Lower California, with a note on the Miocene Diatomite. Jour. Paleol., Vol. 7, No. 4, pp. 438-441, December.
- Hertlein, L. G., and Grant, IV, U.S.
1944. The Geology and Paleontology of the Marine Pliocene of San Diego, California. Part 1, Geology. Mem. San Diego Soc. Nat. Hist., Vol. 2, pp. 1-72, figs. 1-6, pls. 1-18, 1 diagram, August 30.
- Jordan, E. K., and Hertlein, L. G.
1926. Expedition to the Revillagigedo Islands, Mexico, in 1925, VII. Contribution to the Geology and Paleontology of the Tertiary of Cedros Island and adjacent parts of Lower California. Proc. Calif. Acad. Sci., Ser. 4, Vol. 15, No. 14, pp. 409-464, pls. 27-34, text fig. 1, July 22.
- Mina, U. F.
1956. Bosquejo Geológico de la parte Sur de la Península de Baja California. Congreso Geológico Internacional, Vigésima Sesión, México, Excursión A-7, pp. 1-7a, maps.
1957. Bosquejo Geológico del Territorio sur de la Baja California. Asociación Mexicana de Geólogos Petroleros, Vol. 9, Nos. 3 & 4, pp. 141-269, text figs. 1-8, 1 map (in pocket), March-April.
- Santillán, M., and Barrera, T.
1930. Las Posibilidades Petrolíferas en la Costa Occidental de la Baja California, entre paralelos 30° y 32° de latitud norte. An. Inst. Geol. México, Vol. 5, pp. 1-37, 6 plates (12 half-tone photos), geol. map [Lam. 1(1).]